Edited by José A. Mari Mut, 2026

The Flower Organs of *Commelina erecta*[1]

Juan A. Rivero and José R. Almodóvar

Department of Biology, University of Puerto Rico, Mayagüez, Puerto Rico 00681

Abstract

Examination of the sexual floral organs of *Commelina erecta* revealed an interesting number and configuration of the stamens. There is a central stamen with a large bifid anther, two lateral stamens with a long, curving style and elongated anthers facing downwards or sideward, and three small, posterior staminoids terminating in four petaloid structures. The pistil occupies a central position between the lateral stamens and ends up in a small, capitate stigma between the lateral anthers. Syrphid flies of the genus *Ocyptamus* visit the flowers occasionally, apparently to rob pollen but, unless accidentally, do not seem to function as pollinators. Bees, on the other hand, are embraced by the lateral anthers on the corbicular area, and are rubbed by the stigma on the ventral surface, suggesting a possible case of coevolution between flower and bee. The flower can be self-pollinated but cross-pollination may add genetic diversity to a plant whose distribution is apparently dependent on soil transport.

Introduction

The family Commelinaceae consists of about 40 genera and 640 species with worldwide distribution. Puerto Rico has four genera and fourteen species, and *Commelina erecta* is one of the four members of the genus on the Island.

Commelina erecta has a wide distribution, extending from eastern United States to Argentina but it has also been reported from tropical Africa. Although a common weed in Puerto Rico, its spotty distribution suggests a recent introduction (or a limited power of dispersal), although it was reported by Urban (1898-1928) and by Britton and Wilson (1923) (as *C. elegans*), and Stahl (1882-1888) painted an aquarelle of a white form that some botanists have identified as *C. erecta*. The main author lived a good portion of his life in the country and never saw the species until about 15 years ago when, impressed by a colorful patch at the Vocational School at Mayagüez, brought some seeds and planted them in his garden. It has since become a weed but only in the surroundings of the house, not in the rest of his three acres property. Since then, a small patch has been seen along the road, about two kilometers away, but it does not occur in extensive areas where it could occur, as in the Mayagüez campus of the University or in the Zoo grounds.

[1] This article was first published in the online journal Philica, no longer available. It was edited from the Word file.

Although it propagates vegetatively and by seeds, it seems to depend on soil transportation for its distribution.

Commelina erecta is known locally by the name of cohítre azul or cohítre gigante (gigante- giant, because the flower is much larger than in the similarly colored but much smaller *Commelina diffusa*). The flower of the cohítre gigante is about ½ inch in diameter and there are two blue, upper petals and a much smaller white lower petal which is probably responsible for its English name of White throated day flower. The "interior" of the flower looks yellow, making a nice contrast with the blue "exterior". The flower rests on a boat-like bract or spathe that is closed towards the base, a character that distinguishes it from its congeneric *C. diffusa.* There may be one or two flower buds within the "boat". Flowers only open during the morning hours, between dawn and noon.

It is the sexual organs that make *C. erecta* peculiar and interesting (Figs. 1, 3). The ovary is superior, situated above the insertion of the other floral parts, and the pistil is long, tubiform, minutely capitate (actually divided into three little lobes) and usually curving distally to end between the two lateral stems. When not covered by pollen, the tip (stigma) is violet, a color that may extend, in a diluted form, to the tube (style). There are three types of stamens: a central, voluminous one which, when mature, has a butterfly-like shape (Fig. 3), three shorter, flower-like staminoids ending in what appears to be four yellow "petals", two of which are longer than the other two and have a short, basal appendage (Figs. 4, 6), and two long, lateral stamens with curved filaments that, together, form a heart-shaped figure with the apex pointing towards the center of the flower (Figs. 1-3). The filaments are pinkish violet and the anthers, which look like felt brushes, usually point downwards or laterally. The pistil may occasionally be short and coiled or be absent altogether.

Fig. 1. Open flower of *Commelina erecta*
st - staminoid; cs - central stamen;
Is - lateral stamen; p - pistil

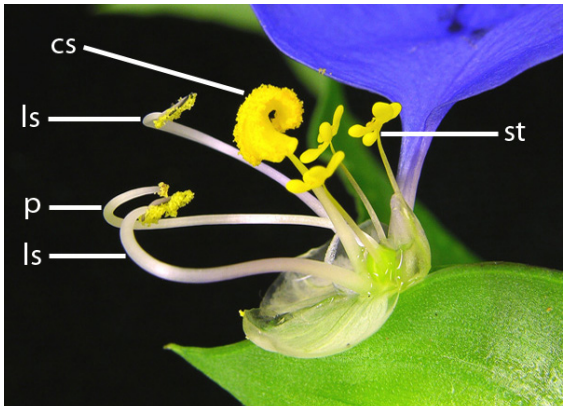

Fig. 2. Sexual organs of *Commelina erecta*
cs - central stamen; Is - lateral stamen,
p - pistil; st - staminoid

Such a distinct sexual apparatus seems to demand a specialized pollinator and perhaps an elaborate co-evolutionary process between pollinator and pollinated. The fact that the staminoids are quite different in related species of *Commelina* (Fig. 5) in which the other sexual organs are very similar may reveal that they serve to attract different visitors.

The Commelinaceae do not produce any nectar and, according to Faden (1992), this has the consequence "that the flowers rarely attract whole classes of pollinators, notably butterflies, moths, birds and bats". The only reward offered by the flower is thus its pollen and as a result, the main visitors of the flowers are social and solitary bees and syrphid flies (op. cit)

Fig. 3. Butterfly shape of mature central stamen of *C. erecta.* Staminoids behind.

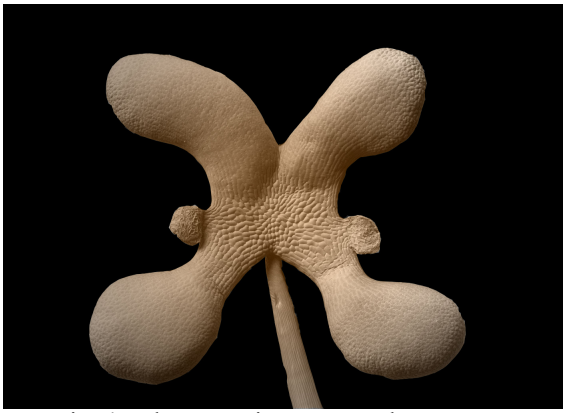

Fig. 4. Electron microscope enlargement of the staminoid of *C. erecta.*

Ushimaro et al. (2007) don't say if there are two types of rewarding anthers but in a following paragraph they write that "removal of the rewarding yellow anther diminish hovering in front of the flowers", which makes one suppose that there is only one rewarding anther. This is contrary to the situation in *Commelina erecta*, where there are two types of pollen laden anthers and only the staminoids are sterile. On the other hand, Deyrup (1988) described Floridan *C. erecta* as having "a single, large, fertile anther, three sterile yellow anthers and two inconspicuous fertile anthers". As the two lateral anthers of *C. erecta* in Puerto Rico cannot be said to be inconspicuous (Fig. 2) it was thought that Deyrup could have had a different variety (there are two subspecies in Florida, *angustifolia* and *erecta*, and only one in Puerto Rico, *erecta*), but it was learned that the separation into subspecies is based, mostly, on leaf and spathe differences. Since conspicuousness is a relative term it just seems that what was inconspicuous to Deyrup is quite conspicuous to us.

Fig. 5. Staminoids of a white *Commelina* similar to *C. erecta*.

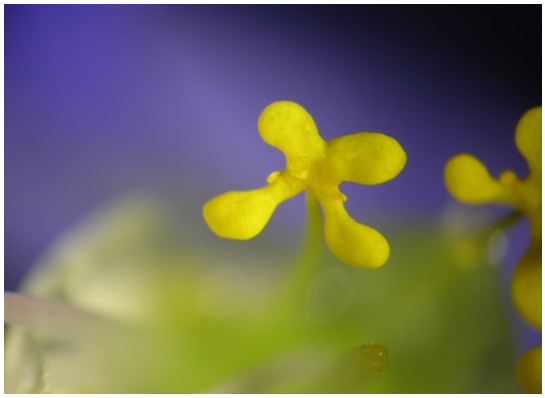

Fig. 6. Staminoid of *C. erecta*.

Materials and Methods

The authors are not pollination biologists and this study was stimulated by the accidental examination of the flowers of *Commelina erecta* and noticing the peculiar configuration of the flower's sexual organs. The aim of the study was to try to determine how these sexual organs function and how is their configuration related to the insects visiting the flowers.

Observations of the flowers of *C. erecta* was made in three places, all in Mayaguez, Puerto Rico, as follows:

SITE 1. In the garden of one of the authors, in a plot three meters long and one meter wide, where the ascending branches of *C. erecta* protrude over the other vegetation in the thicket (Fig. 7). There were, simultaneously, between six and 21 flowers opened at the same time. Seedlings were seen growing at the edge of the patch, and plants sprouting vegetatively from the rooted nodes of *Commelina's* crawling branches were relatively common. The only insect predators seen were several small and medium size lizards (*Anolis cristatellus*), which were scattered in the vegetation, and a small spider whose web was removed daily.

Fig. 7. Site 1 in the garden of one of the authors.

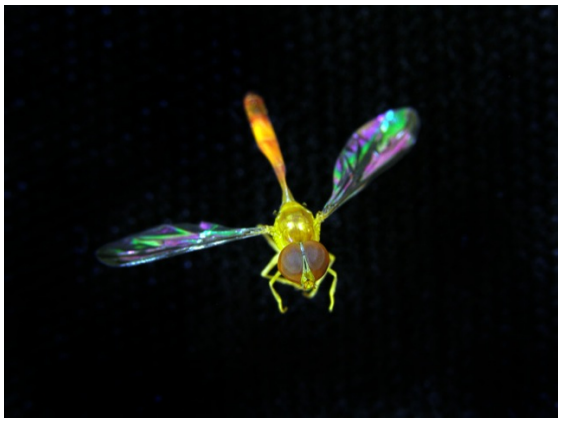

Fig. 8. *Ocyptamus parvicornis*
.

Observations were done from a stool one or two feet from the plant thicket. On two occasions they were extended for the 6 hours of flower duration, but on seeing the low level of activity of flower visitors, they were limited to one hour in the early morning and two in the late morning, although occasional visits were made at any time.

The only visitors of the flowers during 21 hours of observation were two species of syrphid flies of the genus *Ocyptamus (O. cylindrica and O. parvicornis,* Figs. 8, 9, 10). They visited very infrequently, and after 30 hours of observation only four (two of each species) had been collected. They came one at a time and only during the very early or very late hours of the morning. None were seen in the intervening hours and absolutely no other insect visitor was noticed during this period. However, after the 21 hours of observation a bee came almost daily, very early in the morning, and made a very brief visit to 7 or 8 flowers.

Fig. 9. *Ocyptamus cylindrica* feeding on the pollen of *C. erecta*.

Fig. 10. *Ocyptamus parvicornis* feeding on the pollen of *C. erecta*.

The behavior of the syrphids was more or less stereotyped. They came to the area, hovered above a leaf, moved over to another leaf, hovered between flowers, settled briefly on a flower, moved away and hovered over another leaf before finally settling on the previously visited flower. They appeared to be very cautious and any movement of the foliage would make them fly away.

As the numerous seedlings surrounding the study plot are a clear indication that the plants are reproducing sexually, the scarcity of insect visitors was considered fair evidence against the necessity of cross-pollination. To confirm this, 10 small bags, 2 inches in mouth diameter and 4 inches long, and of a very light mesh (of the kind used in spiral hams) were inserted around the flowers very early in the morning, before the flowers opened (Fig.11). The cylinders were tied at both ends and marked with the date and a red string. If the flowers could self pollinate, seeds would appear within the “boats”, inside the mesh bags, some weeks after their installation.

Fig. 11. Mesh bags used to exclude pollinators.

SITE 2. This site was prepared to facilitate observation. Sixteen plants were planted in four inch pots and placed on an improvised table four feet long and 1 1/2 feet wide (Fig. 12). The table was placed at the edge of a house porch, which permitted very frequent observations. As no insect visitors were ever seen at this site, the possibility of any small one crossing the mesh barrier and pollinating the flowers within the bags was much reduced or perhaps eliminated.

Fig. 12. Improvised table with 4 inch pots containing *Commelina* plants.

SITE 3. In the field, at the edge of Rd. 348 Interior, Km. 2.5, Barrio Quebrada Grande. Although there was scrub, some of the plants were growing in clear areas (Fig. 13), and no predators were detected. Only honeybees and an occasional ant were seen visiting the flowers. No mesh bags were used at this site.

Fig. 13. *Commelina* plants growing in SITE 3.

Results and Discussion

The mouthparts of syrphid flies are not mechanically adapted to eat pollen (Fig. 14, 15), but this is the only food resource in *Commelina*.

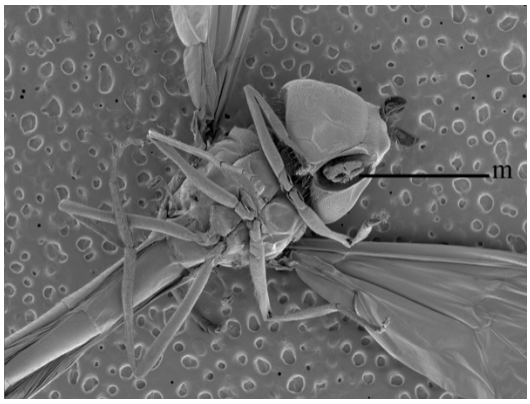

Fig. 14. Mouthparts of the syrphid fly *Ocyptamus parvicornis*.

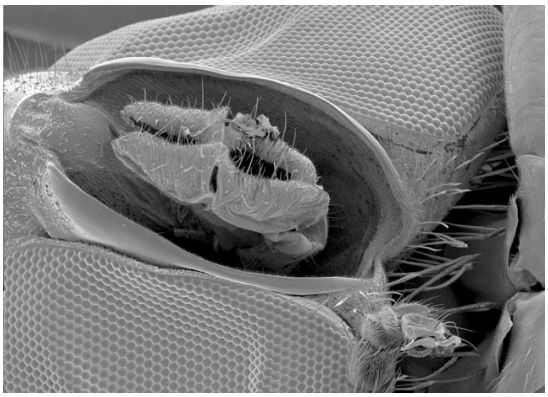

Fig. 15. Electron microscope enlargement of the mouthparts of the syrphid fly *Ocyptamus parvicornis*.

It is known, however, that several species of flies, including bombylids and syrphids, have solved the problem by secreting a digestive juice over the pollen mass, a procedure that permits their imbibitions of the pollen grains (Holloway 1976). From all indications, syrphids visit *Commelina erecta* flowers to eat pollen. Deyrup (1988) indicates that some species of syrphids accumulate pollen in the front tarsi, removing it with the labellum. No modifications of the tarsi that could serve that purpose was noticed in the two species described here but there is a line of bristles in the back of the head that could serve to scrape the pollen, not in the direction of the mouth, as the brittles point backwards, but in the direction of the thorax. There is a second line of very short bristles between the last two pairs of legs in *O. parvicornis* (Fig. 16), but no pollen grains were ever found in association with these bristles or anywhere else on the body of the flies.

Fig. 16. Bristles on the ventral side of *Ocyptamus parvicornis*.

The plant seems to provide a good food source but, unless accidentally, the flies do not seem to contribute to its pollination. Yet, some syrphid flies are said to be excellent pollinators, especially in orchards. As 8 of the 10 flowers enclosed in the mesh bags had

from 3 to 4 seeds it is evident that cross-pollination is not required for the propagation of *C. erecta*.

The situation at SITE 3 was completely different from SITE 1. No syrphids were ever seen here but honeybees were abundant and they were not scary or cautious, easily permitting close up photography. The blue color of the petals is within the range of the visual "expertise" of bees, whose visible spectrum is shifted towards the shorter wave lengths, and the three flower-like staminoids with separate "petals" show the broken pattern that is said to be especially attractive to bees (von Frisch, 1971). Although bees are color blind to red, yellow and orange fall within the 550-650 mu range of their visible spectrum (op. cit). But the most impressive aspect of the relationship between insect and flower is the position of the lateral stamens while the bee is feeding on the central anther. They seem to embrace the bee on the sides, and the downward or laterally pointing anthers of these stamens permit their pollen bearing surface to reach the corbicula or pollen basket, which is on the inner side of the hind tibia. (Figs. 17, 18). When a bee with empty corbicula comes and feeds only in the central anther, it leaves with the corbicula laden with pollen from the lateral anthers. However, in some cases the bee moves around indiscriminately and eats from both the central and lateral anthers, and more often than not, it goes directly to the staminoids and muzzles them for a while, before moving to the central anther (Fig. 19, 20)

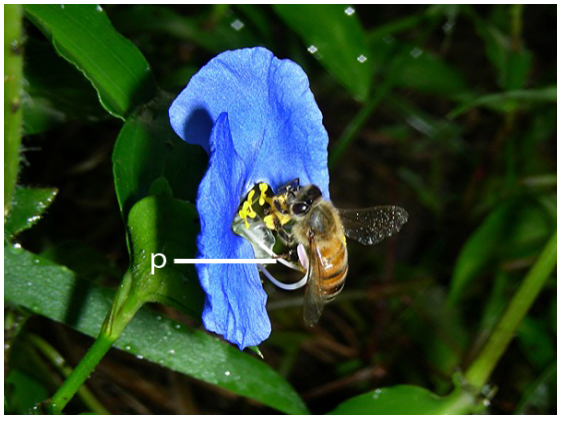

Fig. 17. Lateral anthers rubbing the corbicula of a honey bee while the pistil (p) scrapes the ventral aspect of the insect.

Fig. 18. Lateral anthers rubbing the sides of a honey bee near the corbicula while the insect is eating from the central anther.

While the bee is eating from the central anther or muzzling the staminoids, the pistil, if uncoiled, will be rubbing the ventral aspect of the bee with its stigma, and probably receiving the pollen grains from the corbicula of the moving insect.

The embracing of the bee by the lateral anthers, the position of the pistil, the color of the flower and the broken pattern of the staminoids suggest a close relationship between the

bee and the flower, and the possibility of a coevolutionary process to account for the parity. Evans et al. (2003) indicate that "of the 41 genera of Commelinaceae, only six occur in both Old World and New World." and that " The remaining eight genera of the tribe Commelinae are found exclusively in Africa, Asia and Australia, suggesting an Old World origin of the tribe". On page 286 they assert that some of the early clades of the Commelinaceae are of African origin (one, *Cartonema,* is mostly Australian) and suggest "an eastern Gondwanan origin for the Commelinaceae". *Polyspatha,* from tropical west Africa, usually clusters with *Commelina* in several of the cladograms offered by the authors, and *Aneilema* and *Rhopalephora*, two other closely related genera are mostly (*Aneilema* has one species in America and 62 in Africa) or exclusively, African. Such being the case, it is difficult to determine what the authors meant by "eastern Gondwana" as Africa was part of Western (Afroamerica), not Eastern Gondwana.

Fig. 19, 20. Honey bee mouthing the staminoids of *C. erecta.* Notice, in Fig. 20, the corbicula and position of the anthers.

The honeybee is from Eurasia and Africa, and *Commelina erecta* although mostly American has also been reported from Africa. For a coevolutionary process to have occurred we would have to think that *C. erecta* actually originated in Africa, together with the honeybee (not impossible on the basis of what is said in the previous paragraph) or that it developed its flower in association with some American bee morphologically similar to the honeybee. The honeybee just "took a ride" on the evolutionary process. *Commelina erecta* is self pollinating, not requiring a pollinator to reproduce sexually, but cross pollination adds to its genetic diversity, and this may have had a great selective value in the evolution of this plant.

Acknowledgements

The authors thank Dr. Niko Franz for his help in identifying the syrphid flies

Literature Cited

Brashier, C.K. 1966. A revision of the genus *Commelina*. Bulletin Torrey Botanical Club 23 (1) 1-19.

Briton, N.L.and P. Wilson. 1923. Botany of Puerto Rico and the Virgin Islans, Scientific Survey of Puerto Rio and the Virgin Islands, Vols. V and VI, New York Academy of Sciences, N.Y.

Deyrup, M.A. 1988. Pollen feeding in *Poecilognathus punctipennis* (Diptera: Bombylidae). Florida Entomologist 7 (14) 577-605.

Evans, T.M., K.J. Sytsma, R.B. Faden and T.J. Givinish. 2003. Phylogenetic relationships in the Commelinaceae: II. A cladistic analysis of rbcL sequences and morphology. Systematic Botany. (2): 270-292.

Faden, R.B. 1992. Floral attraction and floral hairs in the Commelinaceae. Annals Missouri. Botanical Garden.7 (1) 46-52.

Holloway, B.A. 1976. Pollen feeding in hover flies. (Diptera: Syrphidae). New Zealand Journal of Zoology 3, 339-350.

Telford, H.S. 1973. The Syrphidae of Puerto Rico. University of Puerto Rico, Journal of Agriculture 217-246.

Urban, I. 1898-1928. Symbolae antillanae, 9 volumes. Berlin.

Ushimaro, A, T. Watanabe and K. Nakata. 2007. Colored floral organs influence pollinator behavior and pollen transfer in *Commelina communis* (Commelinaceae). American Journal Botany 94:249-258.

Von Frisch, K. 1971. Bees, their vision, chemical senses and language. Cornell University Press, Ithaca and London.

NOTE TO THE READER

This article was published in 2009 in the online journal Philica, whose content is unavailable.